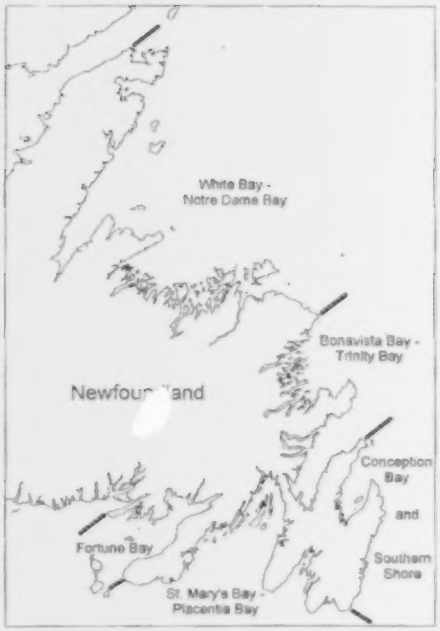


EAST AND SOUTHEAST NEWFOUNDLAND HERRING

Background

There are five herring stocks distributed along the east and southeast coasts of Newfoundland: White Bay - Notre Dame Bay, Bonavista Bay - Trinity Bay, Conception Bay - Southern Shore, St. Mary's Bay - Placentia Bay, and Fortune Bay. These stocks are characterized by the predominance of spring-spawning herring which are fully mature by age 5 and can live to age 20. Growth is most rapid at earlier ages, herring at age 4 being an average of 27 cm in length and at age 10, 35 cm.

Survival of young herring (ie. recruitment) in these stocks is largely influenced by environmental conditions, principally overwintering water temperatures and salinities prior to spawning. As herring within the region are at the northernmost extension of their range, strong recruitment tends to be very sporadic. Large year classes of herring produced in the late 1960's supported the stocks through the 1970's. There was poor survival of all year classes until 1982 and since then only the 1987 year class has been of moderate strength. Year classes produced in the early 1990's are currently dominant in the mature biomass and appear to be of varying strength.

Historically, these stocks have supported commercial food and bait fisheries. The fishery along the northeast coast developed in the mid 1970's and peaked during the late 1970's as a result of increased markets due to the collapse of the North Sea herring fishery. The fisheries in all stock areas were closed in the early 1980's due to declining stock sizes but were reopened in the mid 1980's with the recruitment of the 1982 year class. Although controlled by TAC's, the fisheries since then have been largely driven by market availability and in most years quotas have not been taken.

Stock status reports have been prepared for all areas except Conception Bay - Southern Shore, due to its limited commercial fishery in recent years.

Ecological Factors

Harp seal population numbers have increased substantially since the 1980's with concomitant increases in overall fish consumption. Juvenile herring are important in the diet of harp seals in the spring when seals are inshore but are not an important prey item when seals are offshore. The consumption of herring by harp seals has not been quantified as it depends upon the percentage of diet derived inshore vs. offshore by the seals. Preliminary results from satellite tracking suggest that the distribution of harp seals and herring overlaps primarily in late winter and early spring. No additional information was available since the last herring assessment.

Little information is available on the consumption of herring by cod and other groundfish in inshore Newfoundland waters as there is no specific inshore time series of groundfish feeding data.

Herring form an opportunistic part of the diet of gannets in Newfoundland waters, the impact of which is not significant upon the stocks.

Ocean temperatures in 1997 were close to the long-term average. A warming environment increases the probability of good recruitment to these herring stocks.

Assessment Methods

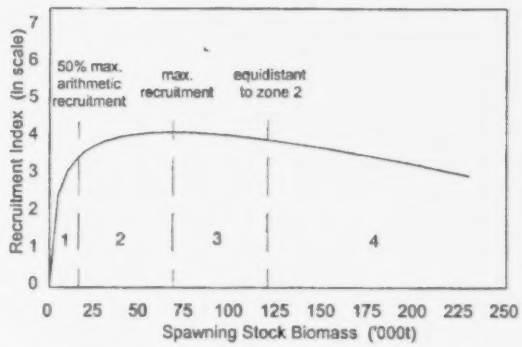
Five series of abundance indices were available for each of the herring stock areas, research gill net catch rates and acoustic survey biomass estimates, extending back to the early 1980's, and commercial gill net catch rates, gill net fisher observations, and purse seine fisher observations, commencing in 1996. The gill net and purse seine fishers' observations were derived from questionnaires in which fishers were asked to rate herring abundance on a scale of one to ten, with one being the lowest and ten being the highest.

The research gill net catch rates and acoustic survey biomass estimates were used to estimate population sizes from catch at age data in a sequential population model, ie. integrated catch at age analysis (ICA). The commercial gill net catch rates, gill net fisher observations, and purse seine fisher observations were not used in this analysis due to their limited time series.

Population estimates were derived from the integrated catch at age analysis for all areas except Fortune Bay where catch levels and associated fishing mortalities were too low for the model to accurately estimate population size. Consequently, as in the last assessment of these stocks, the current stock size for Fortune Bay was estimated using a research gill net catchability coefficient.

A stock status classification system, which links exploitation rates to recruitment estimates at given spawning stock levels, was again used in this assessment. The system is derived from stock-recruit relationships developed for each area from an environmentally dependent stock recruitment model. Stock status zones are then defined along these stock-recruit curves with appropriate exploitation levels.

Stock Status Classification System



Zone	Spawning Stock Status	F	Type of Fishery
1	Very Poor	0.00-0.05	Scientific
2	Poor to Moderate	0.05-0.10	Restricted
3	Moderate to Good	0.10-0.20	Commercial
4	Good to Very Good	>=0.20	Accelerated

Stock-recruit relationships were revised since the last assessment for all areas, except Fortune Bay, to incorporate recruitment and biomass estimates to 1996 from the integrated catch at age analysis. The revised relationships provided new estimates of maximum recruitment and hence new biomass reference levels between zones in the stock status classification system.

A risk analysis was conducted for all areas except Fortune Bay to determine the probability of projected mature biomass estimates being less than reference levels in the stock status classification system (Patterson 1998).

Sources of Uncertainty

Accurate commercial catch data is required for the sequential population model.

The sequential population model is sensitive to the manner in which fishing mortality is applied to plus groups, ie. older fish which cannot be aged. For stocks in which a large proportion of the catch consists of these older fish, the fishing mortality applied to these groups can affect historical population estimates.

Constant catchability is assumed in calculating current population estimates for Fortune Bay from research gill net catch rates during the 1970's.

The stock / recruit analyses depend, for the most recent year classes, on the accuracy of sequential populations tuned to current abundance indices from the research gill net and acoustic biomass time series.

White Bay - Notre Dame Bay

The Fishery

Landings in 1997 were 2500 t, 97% of which were taken by purse seines during the fall in the eastern portion of the stock area.

The commercial fishery was dominated by age 6 and 7 herring (1991 and 1990 year classes) which accounted for 80% of the landings.

Landings and TAC's ('000 t)

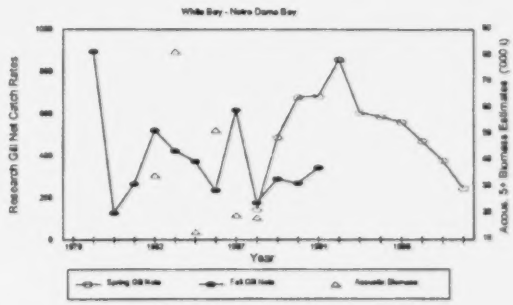
Year	81-85 Avg.	86-91 Avg.	92-93 Avg.	1994	1995	1996	1997	1998
TAC	2.2	19.4	13.5	13.5	1.2	1.6	4.9	4.9
Landings	2.6	7.3	3.7	1.4	1.6	0.7	2.5	

1994-1997 provisional landings

Resource Status

Research gill net catch rates have exhibited a declining trend since 1991 and have decreased by 47% from 1996 to 1998. Similar to the commercial fishery, the 1990 and 1991 year classes dominated in the research gill nets, accounting for 70% of the catch in 1997. There was no evidence of recruitment of year classes subsequent to the 1991 year class.

Commercial gill net catch rates decreased by 65% from 1996 to 1998. The perception of abundance by gill net fishers decreased from a value of 6.0 to 2.1 (on a 10 point scale) over the same period. Purse seine fishers indicated that herring abundance decreased from 7.9 to 6.9 (on a 10 point scale) from 1996 to 1997.

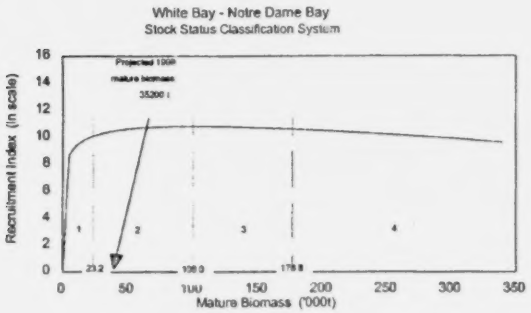


There were no acoustic biomass estimates available since the last assessment.

The 1998 mature biomass estimate from the integrated catch at age analysis is 30800 t.

Summary

These analyses show that this stock is at a low level relative to peak levels in the mid 1970's. This is due to continued poor recruitment through the 1980's and 1990's; there is no evidence of strong recruitment of recent year classes. Based upon the stock classification system, previously described, the status of this stock would be classified in zone 2, ***poor to moderate***.



F	Year	Catch	Probability Mature Biomass < Zone 2
0.05	1999	1800	24.5%
	2000	1800	23.0%
0.10	1999	3500	27.0%
	2000	3300	31.0%

Risk analysis indicates that with 1999 and 2000 catches in the order of 1800 - 3500 t, there is less than 31% probability that the mature stock biomass would decrease to zone 1 within the stock status classification system.

Bonavista Bay - Trinity Bay

The Fishery

Landings in 1997 were 1100 t, approximately 60% of which were taken by purse seines in a fall fishery in both bays.

The commercial fishery was dominated by age 6 herring (1991 year class) which accounted for 75% of the landings.

Landings and TAC's ('000 t)

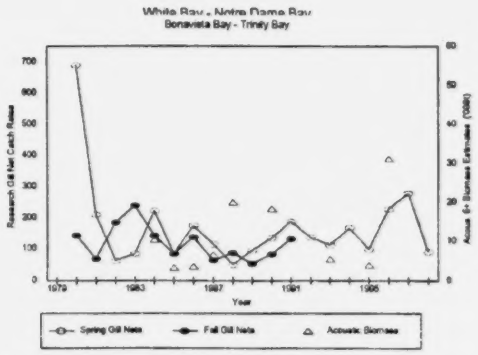
Year	81-85 Avg.	86-91 Avg.	92-93 Avg.	1994	1995	1996	1997	1998
TAC	1.3	12.3	10.0	10.0	1.0	1.4	1.6	1.6
Landings	1.1	6.2	3.5	2.7	1.5	1.1	1.1	-

1994-1997 provisional landings

Resource Status

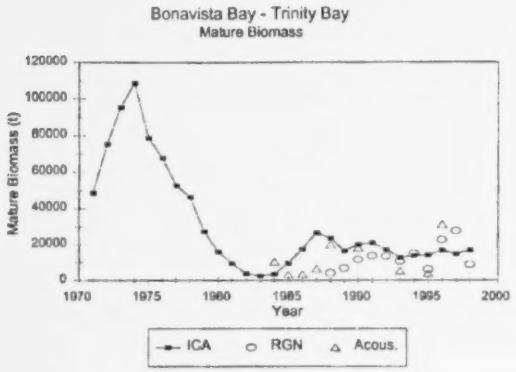
Research gill net catch rates increased from 1996 to 1997 but decreased substantially in 1998 and are currently 60% lower than in 1996. Similar to the commercial fishery, the 1991 year class dominated in the research gill nets in 1997, accounting for 60% of the catch. There was no evidence of recruitment of year classes subsequent to the 1991 year class.

Commercial gill net catch rates decreased by 63% from 1996 to 1998 (based upon a small sample in 1998). The perception of abundance by gill net fishers decreased slightly from a value of 6.1 to 5.7 (on a 10 point scale) over the same period. Purse seine fishers indicated that herring abundance decreased from 8.6 to 6.9 (on a 10 point scale) from 1996 to 1997.



Canada

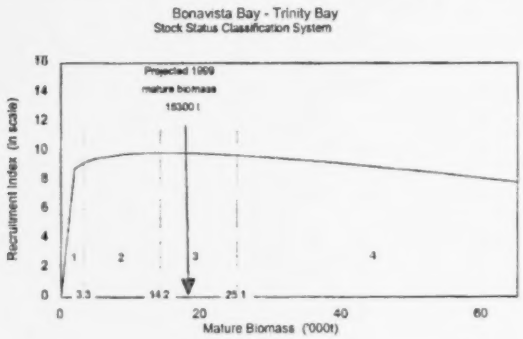
The age 5+ biomass estimated from an acoustic survey in the fall of 1996 was 31200 t.



The 1998 mature biomass estimate from the integrated catch at age analysis is 16800 t.

Summary

These analyses show that this stock is at a low level relative to peak levels in the mid 1970's.



There is no evidence of strong recruitment of recent year classes. Based upon the stock classification system, previously described, the status of this stock would be classified in zone 3, ***moderate to good***.

F	Year	Catch	Probability Mature Biomass < Zone 3	Probability Mature Biomass < Zone 2
0.10	1999	1100	22.5%	1.0%
	2000	1800	17.5%	1.0%
0.20	1999	2200	22.5%	1.0%
	2000	3200	20.5%	1.5%

Risk analysis indicates that with 1999 and 2000 catches in the order of 1100 - 3200 t, there is less than 1.5% probability that the mature stock biomass would decrease to zone 1 within the stock status classification system and less than 22.5% probability that it would decrease to zone 2.

St. Mary's Bay - Placentia Bay

The Fishery

Landings in 1997 were 4000 t, 96% of which were taken by purse seines during the late winter and spring in Placentia Bay and during the fall in St. Mary's Bay.

The commercial fishery was dominated by the 1991 year class, which accounted for 60% of the landings.

Landings and TAC's ('000 t)

Year	81-85 Avg.	86-91 Avg.	92-93 Avg.	1994	1995	1996	1997	1998
TAC	0.4	3.0	1.5	1.5	1.1	0.7	6.6	6.6
Landings	0.2	0.6	1.0	1.0	0.8	0.5	4.0	-

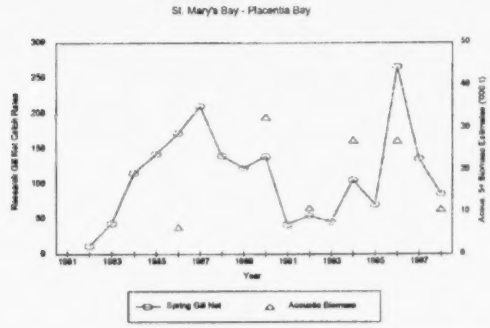
1994-1997 provisional landings

Resource Status

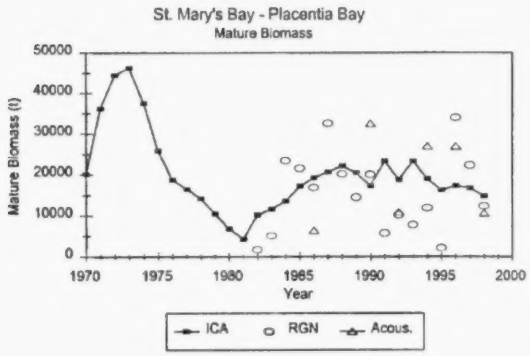
Research gill net catch rates decreased from 1996 to 1998 and are currently 30% of peak values in 1996. Similar to the commercial fishery, the 1991 year class dominated in the research gill nets, accounting for 40% of the catch in 1997. There was limited evidence of recruitment as the 1994 year class accounted for 4% of the 1997 catch.

Canada

Commercial gill net catch rates decreased by 32% from 1996 to 1998. The perception of abundance by gill net fishers decreased from a value of 5.5 to 2.6 (on a 10 point scale) over the same period. Purse seine fishers indicated that



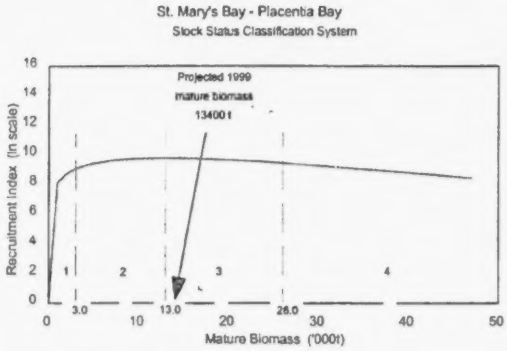
herring abundance decreased from 8.7 to 2.3 (on a 10 point scale) from 1996 to 1998.



The age 5+ biomass estimated from an acoustic survey in the early spring of 1998 was 10700 t. The 1998 mature biomass estimate from the integrated catch at age analysis is 14800 t.

Summary

These analyses show that this stock is at a moderate level relative to peak levels in the early 1970's. There is no evidence of strong recruitment of recent year classes. Based upon the stock classification system, previously described, the status of this stock would be classified in zone 3, ***moderate to good.***



F	Year	Catch	Probability Spawning Biomass < Zone 3	Probability Spawning Biomass < Zone 2
0.10	1999	1100	28.5%	0.0%
	2000	1400	34.0%	0.0%
0.20	1999	2000	32.5%	1.0%
	2000	2500	41.0%	1.5%

Risk analysis indicates that with 1999 and 2000 catches in the order of 1100 - 2500 t, there is less than 1.5% probability that the mature stock biomass would decrease to zone 1 within the stock status classification system and less than 41% probability that it would decrease to zone 2.

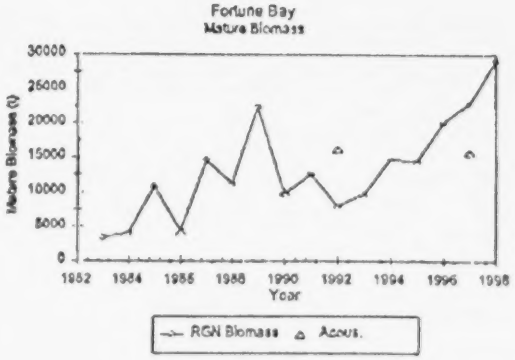
Fortune Bay

The Fishery

Landings in 1997 were 150 t, all of which were taken during the spring gill net fishery. There has been a very limited fishery on this stock since the early 1970's.

The commercial fishery was dominated by age

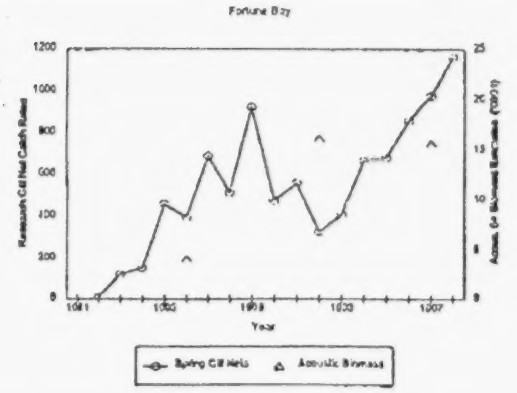
11+ herring, which accounted for 95% of the landings.



Landings and TAC's ('000 t)

Year	81-85 Avg.	86-91 Avg.	92-93 Avg.	1994	1995	1996	1997	1998
TAC	0.1	2.1	1.5	1.5	1.5	0.5	5.4	5.4
Landings	0.1	0.1	0.2	0.3	0.5	0.1	0.1	-

1994-1997 provisional landings



Resource Status

Research gill net catch rates have exhibited an increasing trend since 1992 and are currently the highest in the time series. Similar to the commercial fishery, fish age 11+ dominated in the research gill net catches (40%); however, the 1990 - 1992 year classes also accounted for 45% of the catch. There was no evidence of recruitment of year classes subsequent to the 1992 year class.

Commercial gill net catch rates decreased by 23% from 1996 to 1998. However, gill net fishers indicated that herring abundance increased slightly from 7.2 to 7.8 (on a 10 point scale) over the same time period.

The age 5+ biomass estimated from an acoustic survey in the winter of 1997 was 15100 t.

The 1998 age 5+ biomass estimate from the research gill net catchability analysis is 27300 t.

Summary

These analyses show that this stock is at a good level. Fish aged 11+ continue to contribute significantly to the spawning biomass and there has been very limited fishing mortality. Based upon the stock classification system, previously described, the status of this stock would be classified in zone 4, ***good to very good***.

Canada

The status of this stock has not changed significantly since the last assessment which projected a 1997 mature biomass estimate of 29700 t. A risk analysis at that time indicated that a catch of 5400 t in 1997 would not adversely affect recruitment to the stock. Combined landings for 1997 and 1998 are not expected to exceed 500 t. Consequently, annual catches of 5400 t (F =~0.20) in 1999 and 2000 would have minimal risk to this stock.

This report is available from:

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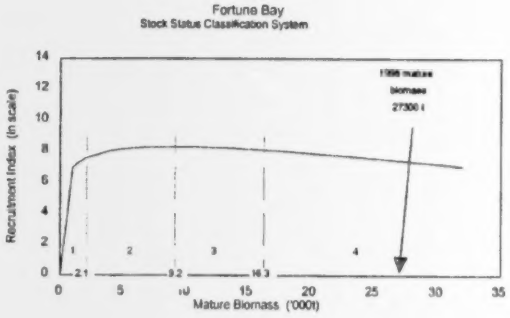

Canada